PIKES PEAK RADIO AMATEUR ASSOC.

Ø BEAT

COLO. SPRINGS, COLORADO

APRIL 1981

Tuning Without QRM

POWERLESS TUNING OF ANTENNA SYSTEMS

Most hams practice the adjustments to their antenna and feedline systems by using discrete transmitting frequencies. Power should be kept low for these sessions, while working within band limits, as a courtesy to other hams. Field strength meters, wattmeters, VSWR meters, even RF ammeters are used as indicators, but the fact remains that in-band "signals" are being radiated... even from a dip meter!

Consider for a moment the use of broadband noise as the source for exciting the antenna system. (Broadband "noise" is that hissing sound from a punctured tire — frying pan — Niagara Falls — or from your VHF receiver with the squelch open). Now, using a frequency-sensitive voltmeter as a null indicator for a bridge, you can find a balance between the known and the unknown. The noise source should be relatively "flat" across the band of interest, and of sufficient amplitude to peg the needle of the voltmeter. Where do you acquire a "frequency-sensitive voltmeter"? Your communications receiver with an S-meter is ideal! It may be either AM, FM, SSB or whatever, as long as it is tunable in the band of interest and it has an amplitude-reading S-meter. Even an audio-type output meter connected to the receiver will work. A visual indicator is far superior to "listening" for a null with loudspeaker or phones (besides, the "noise" is noisy!). Good image rejection is a must, if deep nulls are to be realized. A grid dip meter, in its diode detector mode, will work.

When an unknown resistance is connected across the antenna terminal of the bridge, the bridge will be balanced when the ratio of the unknown (ANT) to RF is equal to the ratio of the two arms of the potentiometer. This relationship causes the dial calibration to be an exponential function. This allows the use of a small value potentiometer, say 100 ohms, to be useful over a wide range of unknown resistances. (Theoretically, the range extends from zero to infinity!) The usual factory setting is 50 ohms, with a variation between 25 and 100 ohms, of course using a calibrated standard. Higher impedances, say 300 ohms, may be converted to the 50 ohm null point by use of a balun transformer matcher.

A word about connecting cables. Ideally, the cable between the antenna and the noise bridge should be "transparent", i.e., an integral multiple of a half-wavelength. A zero-length transmission line may be realized by connecting the noise bridge directly at the antenna terminals, with much success. In this case, the antenna is "illuminated" by the noise energy, and it "drinks-in" the most of this energy at its resonant frequency, indicating a null in the voltmeter at that exact frequency. (This phenomenon occurs, regardless of correct impedance match!) When you have trimmed and adjusted the antenna (array) to the best (deepest) null at the desired frequency, there is plenty of time to optimize the impedance match.

Now, here is your proud antenna (array) trimmed to absolute resonance, and you obviously want to connect a transmission line (50-ohm coax) to it so you can get it up in the air. (The author usually tunes arrays on the ground, using a wood support, such as a stepladder, and pointing beam arrays to the zenith to minimize reflections and absorptions, while tuning.) By the way, mobile antennas may be accurately "tuned" in the same fashion, as long as you have trimmed the feedline in advance. Part Two of this article will deal with feedline pruning and tailoring. A small collection of non-inductive (composition-type) resistors in the 25 to 100 ohm range is very handy to make comparisons for the

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(* Two-year board terms began October 1980)

ZERO BEAT is published monthly in the interest of the members of the Pikes Peak Radio Amateur Association, Inc., Colorado Springs, Colorado. Permission is given to reprint articles or excerpts provided credit is given. Deadline for submission of articles is the 21st of the month. Classifieds accepted anytime.

The Pikes Peak Radio Amateur Association meets on the second Wednesday of each month at Sabin Jr. High School, 3605 N. Carefree Circle at 7:30 p.m. and all amateurs and interested parties are invited to attend.

Editor: Don Lohse KBØKQ, 1410 E. LaSalle, Colorado Springs, CO 80907 635-7469

PIKES PEAK RADIO AMATEUR ASSOCIATION MINUTES MARCH 1981

The March meeting of the Pikes Peak Radio Amateur Association was called to order promptly at 7:30 P.M., March 11, 1981, by club President Dave Vierling, NØDV. The place was Sabin Jr. High. The 54 members and guests introduced themselves. It was noted during the introductions that there were a large number of people who had recently upgraded; congrats all around!

The program this month was a presentation by Dave Gieskieng, WØFK, on his "DL" Antenna. Thanks much Dave for a fine presentation!

The first order of business was the club Swap Fest. Warren, WBØSJR announced that we need people to handle talk in communications and people to direct parking. It was learned from the floor that Charleen, WBØYOB, has made arrangements with the Explorer Scouts to direct parking. A sign up list was passed around for talk in volunteers.

It was decided that the official starting time for the Swap Fest will be 8 A.M. The date is still April 12th. Don, KBØKQ, announced that Zero Beat will be about one week early this time and that each copy will contain a map to the Swap Fest site. Chuck, WØRNT, volunteered to distribute flyers for the Swap Fest. Don also thanked Ray, AAØL, and Oak, KØROL, for their article contributions to Zero Beat.

It was announced that new Novice Classes will begin April 7th, at 7:30 P.M. at North Jr. High. These classes are free to all and worth a ham ticket plus a lot of electronic knowledge. All you have to do is show up.

Ken, KAØDST, hit us in the head with this one: turns out, the restaurant that we meet at on Saturday mornings has been sold and no longer will even be a restaurant. So, looks like we will soon have to find a new Saturday morning haunt.

Art, NØBRN/DV announced that if you fail an upgrade test by only one question, it is now possible to get a waiver from the thirty day waiting period.

Mike, KØTER, announced that the Walk for Mankind will be on May 16th, and he needs volunteers to help with communications.

Biz, WDØHCO, has been to the Spring Spree organization's meeting. The club will be involved but the particulars have yet to be worked out.

Bob, WBØFLU, from the "Mountain Radio Club" will hold their Swap Fest at the Red Rocks campground on August 15 and 16.

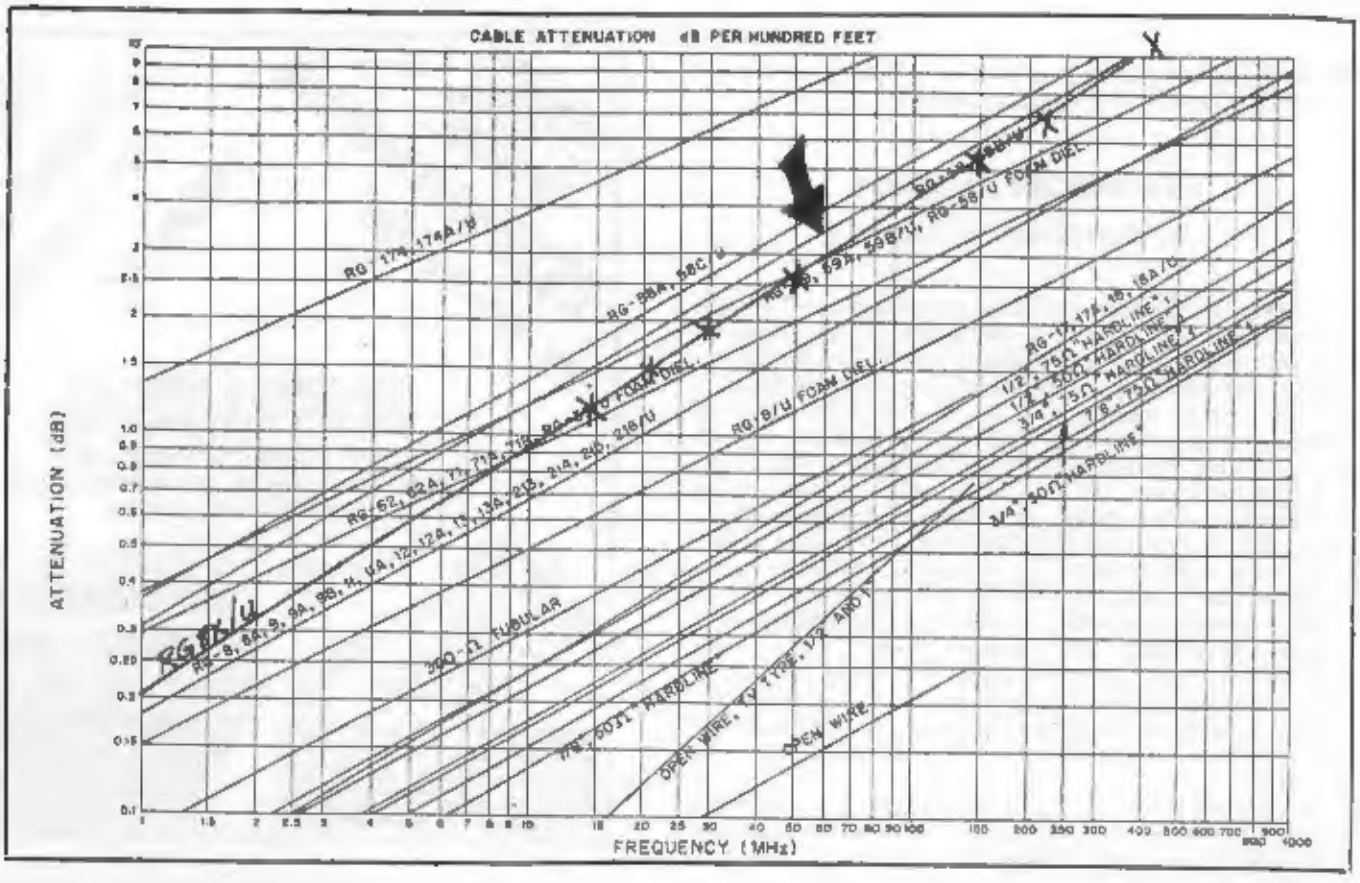
Dave, NØDV, announced that it's once again time to start the machinery in motion for this years field day. Dave asked for volunteers to organize things. I think Mike, KØTER, raised his hand.

Respectfully,
Bill, KFØW

FOR SALE: FT101E, Dummy Load, YC101 Dig Display, Phone Patch YO101 Monitor Scope. $1200/offer. Art NØBRN 1-683-3158. Leave message at 597-6907.

WANTED — Novice Band Crystals 80, 40, 15, 10 Meters Type FT-243 or equivalent — Dave Arnold KAØJZZ, 591-9138 after 5 p.m.

Typesetting courtesy Letter Setters



TECH NOTE

While reviewing the technical data covering the RG 8X/U cable, recently made available to the club by special purchase, I noted a bothersome spec., namely the velocity factor. The Vp was listed as 66%, the same as solid poly coax such as RG 8/U and RG 58/U. Normally foam coax has a Vp, ie. the speed energy travels down the coax compared to the speed of light, of about 75%. The Vp is important in phasing harnesses, balums, traps, transformers, etc.

I set out to measure the coax and found some very interesting results. Both Time Domain Reflectometry (TDR) and RF measurement techniques were used.

Vp—Velocity factor	72.14%
Z—Impedance	42 Ohms

Attenuation (per 100 ft)

14 MHz	21	29	50	146	222	420
1.2 dB	1.5	1.9	2.6	5.4	6.9	11.1

The Vp is very accurate because both RF and TDR techniques agreed exactly and are unaffected by the lower than expected impedance.

The impedance of 42 ohms taken from TDR measurements was confirmed by VSWR measurements but could be off by an ohm or so. Who cares, the cable was not consistant in impedance anyway varying by ±1 ohm. It is not unusual for cable to vary but after looking at both ends of the 100 ft. sample I had, the center conductor was not in the middle at either end. Oh well, if someone sticks pins in your RG 8X/U they may not hit the center conductor this way. Seriously, the off center amount was small so don't worry about it.

Last comes the attenuation. I measured the loss several different ways and the figures given I feel are very good and seem to fit what I would expect. Because of the oddball impedance however the attenuation figures are the most suspect. In reviewing a great deal of literature from manufacturers, ARRL and various other references I found one thing for sure, none of them agree. So, I will follow, submit my findings, and disagree with everyone also. Incidently, I measured a good 100 ft. piece of RG 58C/U and found the attenuation to follow the ARRL Handbook curve but about on the line shown by the arrow.

Many thanks to Jim Colvin NØAVY for letting me use his 100 ft. piece of black stuff for these measurements.

P.S. It's good stuff and well worth the price.

Ray, AAØL

This article is the only printed word so far on the DL antenna. We thank the School of Mines for permission to reprint it.

NEW DIPOLE ANTENNA

by D.H. Gieskieng, WØFK

A new large conductor ring antenna used on NASA space capsule recovery ships was described in the literature concerning the recovery procedure, but the articles did not seem to portray its real potential. To check this and obtain a needed antenna without buying, the "DL" antenna was conceived and constructed, emphasizing the factors of the NASA antenna that actually seemed to be back of its success.

The performance of the "DL" was checked rather thoroughly to a reasonably distant reproduceable condition station located on the top of 11,500 ft. Squaw Mountain, as well as on world wide contacts, and was found to be an unusually strong radiator. It has application for radio use, and potentially for geophysical exploration. It has perhaps also provided some insight as to the composition of radio waves.

Seemingly almost from the beginning, radio waves have been described as being electromagnetic, having an electric oscillation perpendicular to an equal magnetic oscillation, and both of those perpendicular to the direction of travel. (Maxwell)

In explanation of the "DL" performance, an alternative concept is proposed. This is that usual radio waves in space are essentially if not wholly magnetic, until they are cut by a conductor or buffed by an ionized field, and that the term "electro" more aptly refers to the short-lived electric fields generated by antenna resonance as a usually wasted by-product. The waste exceptions seem to be limited to dipole electric fields helping to drive nearby elements of a beam, lighting neon and fluorescent bulbs if held similarly close, or the electric field energy conserved by folding the antenna to a degree that permits magnetic radiation from the middle of the resonance, but contains the electric fields beyond that area.

The "DL" antenna is an end-shorted large conductor symmetrically fed transmission line stub, called "DL" for Discontinuity of (transmission) Line. Since its radiation has been shown by rotation tests to be only from the resonance concentrated high current in the shorting-bar it is essentially magnetic, whereas the main electric and marginal distributed magnetic fields are conserved in the non-radiating line portion. This conservation at least doubles the energy available for driving the magnetic field producing shorting-bar. The antenna by the accumulation of over 500 carefully monitored tests to Squaw Mountain from 11 radiator height and distance accounted locations in the Arvada and Denver area has shown itself to be omni-directionally as strong as the favored direction of 7 Yagi and 1 Quad beams. In another significant comparison with a Quad it was also found to be a better receiver, not having to ask for repeats, whereas the beam did.

Some "sign posts" pointing in the direction of the magnetic only radio wave concept;

1) If the ohmic resistance of the shorting-bar were theoretically reduced slightly to zero, there would be no original phased electric RI component with the magnetic wave.

2) Electron beams in a cathode ray tube can be deflected by a stationary permanent magnet, which has no electric component.

3) Quasars produce very strong low frequency radio waves by the rapid rotation of magnetic Nova remnants.

4) Dipoles are known to have a very close range intense "inductive field," which diminishes very quickly with distance before stabilizing at a lessened reduction rate. This seems due to loss of the electric component. The strength from the "DL's" magnetic radiation has been found to be inversely exponentional, or corresponds to spherical expansion, such as would be expected of a single component.

5) Fig. 1, shows a series of dipole antennas varying in conductor diameter. "A" is of wire so fine that birds often do not see it in flight and break it, yet it has a fairly high "Q" and radiates quite well. As the conductor diameter is increased, as in "B" and "C", lower ohmic resistance is obtained, however the surface area of the antenna also increases, reducing the "Q" by emphasizing capacitive space coupling and useless electric field radiation. In "D", as with the "DL" antenna, large diameter conductor is used to obtain the benefits of low ohmic

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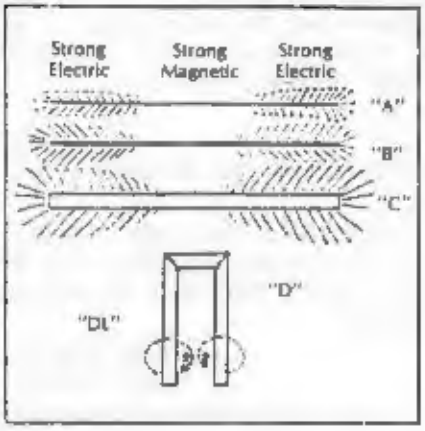
DL (cont.)



Electric field radiation vs. conductor diameter, increasing in dipoles "A", "B" and "C", and conserved in "D" arrangement.

resistance, but by bringing the low current high voltage portions of the antenna parallel in a transmission line stub, the electric and marginal magnetic fields are prevented from radiating and their energy conserved. The containment, as deduced by fluorescent bulbs held about the "DL", indicates that it is due to power swirling about each of the line legs, but the swirl cannot expand or radiate by being forced by the like charge of the other leg's field to compress for the passage between the legs. Due to the nature of a stub there is an exact balance between the impedence of the power field and the line at any plane perpendicular to the lines. This is the reason for the desireability of line and feed symmetry to preserve the balance and prevent ineffective radiation.

The surface area of the large conductor shorting-bar actually provides an "aperture" larger than the magnetically effective portions of many beams. However, due to the shortness of the radiating element in terms of a wave length, it approaches being a "point source," with resolution advantages. The "DL" in rotation tests is omnidirectional and does not exhibit end-nulls common to dipole antennas. Lack of these nulls may be due to the "DL" being a "point source," or it may be an indication that the strong radiating electric fields of a dipole, besides being wasteful, may also be counter productive to some degree.

A "DL" antenna for 20 meters was set up in a field for a fly-over test of the radiation pattern. The antenna in this case is constructed of 4" aluminum irrigation pipe. The same antenna mounted horizontyally on an 80-ft. tower was again rotated to affirm its omnidirectivity and then successfully compared to a nearby Quad beam on a similar tower. Semi-scaled forms of the "DL" antenna have been used for 2 meter single and double beam configurations.

Practical applications include broadcasting where the "DL" antenna can be attached to towers or shipmasts with the line portin off-set parallel to the supporting structure and the radiating shorting-bar at the top at maximum height. Besides being physically much more manageable than the NASA antenna, the symmetry of the "DL" antenna also helps in providing precise phasing to assist in its stated objectives of field conservation, as compared to open line stubs that work a specific conductor against a parallel indefinite plane surface conductor for an image counterpart. A spoked spool version "DL" for UHF use is also practical. The Number of spokes is chosen to balance the operation of the central "shorting-bar."

For geophysics, it has been found practical to place the radiating shorting-bar near, on or slightly in the ground, with the line portion raised at various angles. This provides an efficient means of pulsing and receiving back ground waves that can be initiated with many kilowatts of power. Also, because of the self cancelling of inductions into the leg portions, it is exceptionally quiet in receiving, responding essentially only to excitation of the shorting-bar, but reserving the desirable narrow band tuning aspects of high "Q" stub resonance.

The frequency of operation is a function of the total length of the line legs and shorting-bar. Lower frequencies can be obtained by leg extensions of appropriately sized but not necessarily straight open line, or the line portion be made of coiled large conductor open or single or double conductor coaxial line to assist in transportation. Lower frequency could also be obtained by lumping additional inductance and capacity, but this has its problems in handling the power levels, introducing signatures in the pulse and echos, and reducing the circuit "Q".

Ground waves from this antenna would provide characteristic reflection and absorption alternatives to other seismic waves, to help identify anomalies. It can monitor its own echoes, or be used in conjunction with a spread of other similar antennas. Having been tested in directive radio arrays, it could obviously be used in this manner for ground waves.

It would appear that while usual radio waves are essentially only magnetic and dispersing, that when circular or planar undulating polarization is introduced in degree and ultimately to the forms of subatomic particles and photons, electric fields become integrally important and a significant part of their cohesive forces.

Reprinted from *The Mines Magazine, January, 1981.*

No QRM Tuneup (cont.)

impedance match operation. First, take a guestimate of the impedance of the antenna array, now that it is resonant. Then substitute a 50-ohm resistor for the antenna. Don't change the frequency of your "voltmeter" during this substitution, simply compare the bridge null with the antenna null. Adjust your matching stub, gamma, ringo, delta, BJK, or what have you, to the best (and deepest) null you can get at the frequency of interest. That's all there is to it! Here is an antenna (array) which is not only resonant as a tuned guitar, but it "sees" a 50-ohm load at the same time. Just for fun, hook up your VSWR meter to the system and shoot it some juice. Whatever VSWR you have is probably now attributed to the feedline (unless you previously trimmed it to "transparency"). Part Two will show you methods of precision trimming feedlines to become transparent to standing waves . . . at your frequency of interest. Very helpful for mobile antenna systems . . . with their usual 21 feet of RG-58/U "included in the price".

— Oak KØROL

MEETING NOTICE

The April meeting of the PPRAA will be held on April 8, 1981 at 7:30 p.m. at Sabin Jr. High. The program will be on traffic handling and will be given by Bob Poirier KODJ. All members and interested guest are invited to attend. Due to the length of articles in Zero Beat this month, there was no room for minutes from the last Board meeting. The next meeting will be on April 13 at the home of Don KBØKQ, 1410 E. LaSalle at 7:30 p.m. We regret the omission of the minutes, but think the use of space in Zero Beat is better spent on articles.

FOR SALE Heath 301/401. Good condition-$400. Ralph KAØGJO, 591-2109.

FOR SALE — Heathkit SB-220 Amplifier $450, SB-200 Amplifier $300, SB-600 Speaker $20, HW-12A 75M Transceiver (with HP-13A 12 V Power Sup.) $125. Collins 516 Power Supply $50. Kenwood TR-3200 UHF Transceiver (set up, with x-tals, for Germany) $175, SP-820 Speaker $40, TR-7400A 2 Meter, 25 watt (with 1750 Hz Burst) $340. Eimac 3-500Z (2) together $120. R.H. Stienmier KAØJNL, 576-7263

Received from Jim Russell . . .

Don,

I'm supposed to be a life member, but I feel like I should contribute something. Zero Beat continues to improve, and I think it is an outstanding ham club publication.

Best Regards,
Jim W4AVZ

TNX Jim, we appreciate both your moral and monetary support.

Don, KBØKQ

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Don Lohse KBØKQ
1410 E. LaSalle
Colorado Springs, CO 80907

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